

Artificial Intelligence Tools and Learning Efficiency in Higher Education: Evidence from a Student Survey

Anas Muhammad^{1,a*}, Talha Bin Shakeel^{2,b}

¹Bahauddin Zakariya University - BZU Multan, Pakistan

²Riphah International University Islamabad, Pakistan

^aanas6647355@gmail.com, ^btalha.software.eng@gmail.com

Abstract. Artificial intelligence (AI) technologies are rapidly transforming higher education by offering new tools that support learning, academic writing, and problem solving. Despite growing interest in AI in education, empirical evidence on whether AI-related competencies improve students' academic performance remains limited. This study examines the relationship between artificial intelligence knowledge, perceptions of AI usefulness, and learning efficiency among university students. Using cross-sectional survey data from 91 students, the study employs ordinary least squares (OLS) regression to analyze whether AI-related variables are associated with academic performance, measured by grade point average (GPA). The results indicate that AI knowledge has a positive and statistically significant effect on students' academic performance, suggesting that students with greater familiarity with AI technologies tend to achieve higher GPA. In contrast, perceived usefulness of AI and perceived advantages of AI for teaching and learning do not show statistically significant relationships with academic outcomes. These findings suggest that AI literacy and competence may play a more important role in improving learning efficiency than positive perceptions of AI tools alone. The study highlights the importance of developing students' AI literacy and integrating AI responsibly into higher education teaching and learning practices. The results provide practical insights for educators and policymakers seeking to enhance learning outcomes in an increasingly AI-driven educational environment.

Keywords: Artificial intelligence in education; AI literacy; learning efficiency; academic performance; higher education; generative AI

1. Introduction

Artificial intelligence (AI) has become an increasingly important part of higher education, reshaping how students access information, complete academic tasks, and engage with learning materials. Recent scholarship shows that AI is no longer limited to administrative or technical applications; it is now embedded in tutoring, assessment, adaptive learning, writing support, and personalized feedback systems [2]. The rapid expansion of generative AI tools, especially those that are easily accessible to students, has intensified debate about whether these technologies genuinely improve learning outcomes or simply increase convenience.

In higher education, AI tools such as ChatGPT and related systems are increasingly used for brainstorming, summarizing, language support, drafting, and problem explanation. Research on student perspectives indicates that many university students see generative AI as useful for study support and academic productivity, although they also express concerns about overreliance, academic integrity, and the accuracy of AI-generated content [3]. These mixed perceptions suggest that AI may offer educational benefits, but those benefits are not automatic and may depend on how effectively students understand and use these tools.

This issue has also attracted policy attention at the international level. UNESCO's guidance on generative AI in education and research argues that institutions should move beyond ad hoc responses and instead develop human-centered policies, governance structures, and capacity-building strategies for responsible AI integration [4]. This perspective implies that AI should not be understood merely as a novel classroom tool, but as part of a broader transformation in educational systems, pedagogy, and student learning practices.

At the empirical level, recent evidence suggests that AI can positively affect student achievement, but the strength and consistency of this effect vary across contexts and implementation conditions. A recent meta-analysis found an overall positive relationship between AI and students' academic achievement, while also showing that outcomes depend on factors such as educational level, learning strategy, and the role of AI in the instructional process [1]. This is important because it suggests that positive perceptions of AI alone may not be enough to improve academic performance. Instead, students' actual knowledge, literacy, and competence in using AI may be more important.

Against this background, the present study examines the role of artificial intelligence tools in improving learning efficiency among university students. Using student-level survey data, this study investigates whether AI knowledge, perceived usefulness of AI, and perceived advantages of AI in teaching and learning are associated with academic performance, measured by GPA. By focusing on these dimensions, the study contributes to the growing literature by distinguishing between students' general positive attitudes toward AI and their actual AI-related competence, which may be more closely linked to meaningful learning outcomes.

2. Literature Review

The literature on AI in education has expanded rapidly, especially after the emergence of generative AI tools. A recent systematic review found a major increase in publications since 2022 and showed that AI in education is commonly associated with improved learning outcomes, personalized instruction, and student motivation, while also raising concerns about ethics, dependency, and pedagogical readiness [2]. This indicates that AI is increasingly viewed as a transformative force in education, but one that requires careful implementation and critical evaluation.

A major stream of recent research focuses on students' perceptions of generative AI in higher education. [3], in a large student survey, found that university students often perceive generative AI as helpful for academic work, but they also worry about misuse, fairness, and integrity. Similarly, newer higher-education research published in *Education and Information Technologies* has continued to examine learners' experiences with ChatGPT and related generative AI tools, reflecting strong and ongoing scholarly interest in how these systems influence learning performance and engagement. Together, these studies show that students' acceptance of AI is widespread, but their educational use of AI remains complex and contested.

Another important strand of the literature emphasizes governance and responsible integration. UNESCO's policy guidance argues that educational systems should regulate AI use through ethical standards, privacy protection, teacher training, and student capacity development [4]. This perspective is important because it suggests that educational gains from AI are unlikely to emerge simply from access to tools; instead, institutions must support students in learning how to use AI critically, responsibly, and effectively.

The strongest direct support for the present study comes from recent evidence on academic achievement. [1] Reported in a meta-analysis that AI has a significant positive overall effect on students' academic performance. However, the same study also showed that effects vary depending on the educational context and instructional design. This supports the view that not all dimensions of AI engagement are equally valuable. In practical terms, students who merely believe that AI is useful may not necessarily achieve better academic outcomes unless they also possess the knowledge and skills needed to use it productively.

Overall, the literature suggests three important points. First, AI has become a major component of modern higher education. Second, students generally report favorable attitudes toward AI tools, but these attitudes coexist with concerns about misuse and overdependence. Third, actual educational benefits appear to depend not only on access or perception, but also on AI literacy and effective use. Based on this literature, the present study argues that AI knowledge may be a more meaningful predictor of student learning efficiency than perception alone.

3. Method

3.1 Data and Sample

The This study uses a cross-sectional dataset collected through a student survey examining artificial intelligence (AI) awareness and perceptions in higher education. The final dataset contains 91 observations, each representing an individual university student.

The dataset includes measures of students' knowledge of artificial intelligence, perceptions of AI usefulness in education, perceived advantages of AI for teaching and learning, demographic characteristics, and academic performance. These variables allow an empirical investigation of whether AI-related competencies and perceptions are associated with students' learning efficiency. Academic performance is measured using grade point average (GPA), which serves as a proxy for learning efficiency. Prior studies frequently use GPA as an indicator of academic achievement in educational research [1] [3].

3.2 Variables

Dependent Variable. The dependent variable is academic performance, measured by:

1) (Q16.GPA): Higher GPA values indicate better academic outcomes and are interpreted in this study as reflecting greater learning efficiency.

Independent Variables. The key explanatory variables capture different dimensions of students' interaction with AI technologies:

2) wledge (Q1.AI_knowledge): students' self-reported familiarity with artificial intelligence.

3) ceived usefulness of AI (Q7. Utility grade): students' evaluation of how useful AI tools are for educational tasks.

4) Perceived learning advantage (Q9. Advantage learning): students' perception of AI's benefits for learning activities.

5) Perceived teaching advantage (Q8. Advantage teaching): students' perception of AI's benefits for teaching processes.

Control Variables. Two demographic control variables are included:

6) Gender (Q12.Gender)

7) Year of study (Q13.Year_of_study)

These variables are included because demographic and educational-stage differences may influence academic performance.

3.3 Empirical Model

To examine the relationship between AI-related variables and academic performance, this study estimates an ordinary least squares (OLS) regression model:

$$GPA_i = \beta_0 + \beta_1 AIKnowledge_i + \beta_2 Utility_i + \beta_3 LearningAdv_i + \beta_4 TeachingAdv_i + \beta_5 Gender_i + \beta_6 YearStudy_i + \varepsilon_i \quad (1)$$

Where:

- GPA_i represents the academic performance of student i
- $AIKnowledge_i$ measures students' AI knowledge
- $Utility_i$ measures perceived usefulness of AI
- $LearningAdv_i$ measures perceived learning advantages of AI
- $TeachingAdv_i$ measures perceived teaching advantages of AI
- $Gender_i$ and $YearStudy_i$ are control variables
- ε_i is the error term

OLS regression is appropriate because the dependent variable (GPA) is continuous and the study aims to estimate linear relationships between AI-related factors and academic performance.

4. Results

4.1 Descriptive Statistics

Table 1 Descriptive statistics for all variables used in the analysis

Variable	N	Mean	SD	Min	Max
GPA	91	7.799	1.005	5.200	9.700
AI knowledge	91	5.912	1.858	1.000	10.000
AI usefulness	91	7.440	2.023	2.000	10.000
AI learning advantage	91	1.879	0.716	1.000	3.000
AI teaching advantage	91	1.923	0.804	1.000	3.000
Gender	91	1.352	0.480	1.000	2.000
Year of study	91	1.626	0.486	1.000	2.000

Note. SD = standard deviation.

Table 1 presents descriptive statistics for the variables used in the analysis. The average GPA among students in the sample is 7.799, indicating relatively strong academic performance. Students report moderate familiarity with artificial intelligence, with a mean AI knowledge score of 5.912. At the same time, the perceived usefulness of AI is relatively high ($M = 7.440$), suggesting that most students consider AI tools beneficial in academic contexts. The mean values for perceived advantages of AI in learning ($M = 1.879$) and teaching ($M = 1.923$) indicate moderate agreement regarding the educational benefits of AI technologies. These descriptive results suggest that while students generally perceive AI as useful, their level of AI knowledge varies across the sample.

4.2 Correlation Analysis

Table 2 Presents the correlation matrix among the variables included in the regression model

Variable	1	2	3	4	5	6	7
GPA	1						
AI knowledge	0.273	1					
AI usefulness	0.277	0.359	1				
AI learning advantage	-0.174	-0.166	-0.341	1			
AI teaching advantage	0.073	0.060	0.076	0.003	1		
Gender	-0.217	0.021	-0.086	-0.004	-0.119	1	
Year of study	-0.144	0.070	0.105	-0.071	0.010	-0.145	1

Table 2 presents the correlation matrix among the variables used in the analysis. GPA shows a positive correlation with AI knowledge ($r = .273$) and perceived usefulness of AI ($r = .277$), suggesting that students with greater familiarity with artificial intelligence tend to report slightly higher academic performance. AI knowledge is also positively correlated with perceived usefulness of AI ($r = .359$), indicating that students who understand AI better tend to view it as more useful for academic purposes. In contrast, perceived learning advantages of AI show a negative correlation with both AI usefulness and AI knowledge, suggesting potential differences between students' expectations and their practical experience with AI technologies.

The correlation analysis provides preliminary insights into the relationships among the variables. In particular, AI knowledge shows a positive association with GPA, suggesting that students with greater familiarity with AI may achieve higher academic outcomes. However, correlation analysis alone does not control for other variables, so regression analysis is required for more reliable inference.

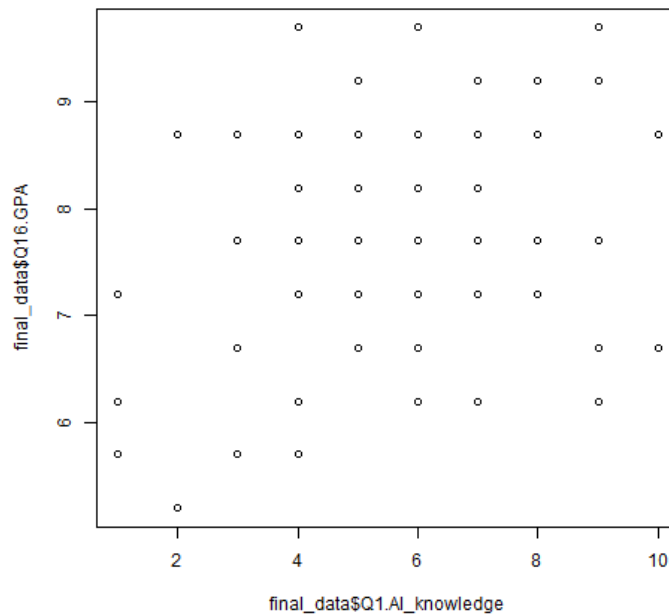


Figure 1 Relationship Between AI Knowledge and GPA

4.3 Regression Results

Table 3 Reports the results of the OLS regression analysis examining the determinants of student GPA.

Variable	Coefficient	Std. Error	t	p
Intercept	8.1857	0.7472	10.956	< .001
AI knowledge	0.1071	0.0518	2.069	.042
Utility grade	0.0752	0.0498	1.510	.135
Advantage learning	-0.1408	0.1486	-0.947	.346
Advantage teaching	0.0243	0.1083	0.224	.823
Gender	-0.4816	0.2019	-2.385	.019
Year of study	-0.4367	0.1981	-2.204	.030

Model statistics

- Observations = 91
- R² = 0.2069
- Adjusted R² = 0.1502
- F = 3.652
- p = .0029

The regression results show that AI knowledge has a positive and statistically significant effect on GPA ($\beta = 0.107, p < .05$). This indicates that students who possess greater knowledge of artificial intelligence tend to achieve higher academic performance.

In contrast, perceived usefulness of AI and perceived advantages of AI for teaching and learning do not show statistically significant relationships with GPA. These findings suggest that actual AI competence may be more important for learning outcomes than perceptions of usefulness alone.

The control variables also reveal significant effects. Gender and year of study both show negative coefficients, indicating that demographic and educational-stage differences may influence academic performance within the sample.

Overall, the results highlight the importance of AI literacy and technological competence in enhancing students' learning efficiency.

5. Discussion

The purpose of this study was to examine whether artificial intelligence (AI)-related knowledge and perceptions are associated with learning efficiency among university students, using GPA as a proxy for academic performance. The results show that AI knowledge has a positive and statistically significant relationship with GPA, whereas perceived usefulness of AI, perceived advantages of AI for learning, and perceived advantages of AI for teaching are not statistically significant. This pattern is meaningful because it suggests that knowing about AI may matter more than simply holding favorable opinions about it.

This finding is consistent with recent scholarship arguing that the educational value of AI depends not only on access to tools, but also on learners' capacity to use them effectively and critically. Recent meta-analytic evidence indicates that AI can improve academic achievement overall, but the magnitude of that effect depends on contextual and instructional factors rather than AI exposure alone. In the same spirit, student-survey research in higher education shows that many students view generative AI positively, yet their experiences also include concerns about misuse, dependency, and academic integrity. Taken together, these studies support the interpretation that AI literacy is likely to be more consequential than attitude alone.

The positive coefficient on AI knowledge suggests that students who better understand AI may be more capable of using these tools for academically productive purposes, such as clarifying difficult concepts, organizing ideas, improving drafts, or accessing explanations more efficiently. In contrast, students who merely believe AI is useful may not necessarily translate that belief into stronger academic outcomes. In practical terms, this means that the educational benefit of AI appears to be mediated by competence and informed use rather than by enthusiasm alone. This is an important distinction for higher education institutions that are rapidly integrating AI into teaching and learning environments.

The insignificant coefficients for perceived usefulness and perceived teaching and learning advantages are also theoretically important. They indicate that positive perceptions of AI should not automatically be interpreted as evidence of improved learning performance. Students may report that AI is useful because it is fast, accessible, or convenient, but convenience does not necessarily produce deeper understanding or better grades. This interpretation aligns with UNESCO's guidance, which emphasizes that the successful educational integration of generative AI requires human capacity development, institutional governance, and responsible use frameworks rather than unstructured adoption.

The control variables also reveal notable patterns. Gender and year of study are both statistically significant in this sample, indicating that demographic and academic-stage differences may shape student performance. These results should be interpreted cautiously because the sample is relatively small and limited in scope. Still, they suggest that AI-related learning outcomes may not be uniform across student groups. Recent higher-education research also reports meaningful differences in perceptions and use of generative AI across student subgroups, reinforcing the idea that institutions should avoid one-size-fits-all assumptions.

Overall, the findings of this study contribute to the emerging literature by making a narrower but important point: AI knowledge is a more meaningful predictor of academic performance than general positive perception of AI. This helps move the discussion beyond broad claims that AI is either beneficial or harmful. Instead, the evidence suggests that the educational impact of AI depends on how well students understand and use it.

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7. Practical Implications

The findings have several implications for universities and instructors.

First, higher education institutions should invest in AI literacy training rather than assuming that students already know how to use AI productively. If AI knowledge is linked to better academic performance, then workshops, short courses, and guided classroom activities on responsible and

effective AI use may improve learning outcomes. This implication is consistent with UNESCO's position that capacity building is central to responsible AI integration in education.

Second, instructors should integrate AI into pedagogy in a structured and supervised way. Students should not simply be told that AI exists or be left to use it independently without guidance. Instead, teachers can show students how to use AI for brainstorming, concept explanation, revision support, and feedback while also discussing its limitations, risks, and ethical boundaries.

Third, universities should develop clear policies and academic integrity guidelines on AI use. Student acceptance of generative AI is already widespread, but acceptance without governance may produce inconsistency and misuse. A policy environment that combines opportunity with accountability is therefore essential.

8. Limitations and Future Research

This study has several limitations.

First, the sample size is relatively small, with only 91 observations. Although adequate for a class-based empirical study, a larger sample would improve statistical power and generalizability.

Second, the analysis is based on cross-sectional survey data, so the results should be interpreted as associations rather than strong causal effects. It cannot be concluded with certainty that AI knowledge causes higher GPA; it is also possible that academically stronger students are more likely to learn about AI.

Third, the dependent variable is GPA, which is used here as a proxy for learning efficiency. While reasonable, learning efficiency is broader than academic performance alone and may also include time management, engagement, retention, and skill development.

Future studies should use larger and more diverse samples, include additional measures of learning outcomes, and, where possible, adopt longitudinal or experimental designs. Future research may also examine whether the relationship between AI knowledge and academic performance is mediated by variables such as self-efficacy, study habits, digital literacy, or teacher support.

Table 4 Definitions and measurements of all variables

Variable	Survey code	Definition	Measurement
GPA	Q16.GPA	Student academic performance	Continuous variable; higher values indicate better academic performance
AI knowledge	Q1.AI_knowledge	Student self-reported knowledge of artificial intelligence	Scale from 1 to 10; higher values indicate greater AI knowledge
AI usefulness	Q7.Utility_grade	Student perception of the usefulness of AI in education	Scale from 1 to 10; higher values indicate greater perceived usefulness
AI learning advantage	Q9.Advantage_learning	Student perception of AI's advantage for learning activities	Ordinal scale from 1 to 3; higher values indicate stronger perceived learning advantage
AI teaching advantage	Q8.Advantage_teaching	Student perception of AI's advantage for teaching activities	Ordinal scale from 1 to 3; higher values indicate stronger perceived teaching advantage
Gender	Q12.Gender	Student gender	Coded variable: 1 = Male, 2 = Female
Year of study	Q13.Year_of_study	Student academic year	Coded variable: 1 = First year, 2 = Second year

Table 4 presents the definitions and measurements of all variables used in the empirical analysis. The dependent variable is GPA, which serves as a proxy for academic performance and learning efficiency.

The main explanatory variables capture students' knowledge of artificial intelligence, their evaluation of its usefulness, and their perceptions of AI-related advantages in learning and teaching. Gender and year of study are included as control variables to account for demographic and educational-stage differences in academic outcomes.

9. Conclusion

This study examined the role of artificial intelligence tools in improving learning efficiency among university students. Using survey data from 91 students, the analysis found that AI knowledge is positively and significantly associated with GPA, while perceived usefulness of AI and perceived advantages of AI for teaching and learning are not statistically significant.

The main conclusion is that AI competence matters more than perception alone. Students do not benefit academically from AI simply because they think it is useful; rather, benefits are more likely when they possess the knowledge needed to use AI effectively, critically, and responsibly. This conclusion is consistent with the broader literature showing that the educational effects of AI depend on implementation quality, learner capability, and institutional support.

In this sense, the study contributes a practical message for higher education: universities should move beyond general enthusiasm for AI and focus on building student AI literacy, ethical awareness, and guided instructional use. Doing so is more likely to convert AI from a convenient technology into a meaningful educational resource.

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